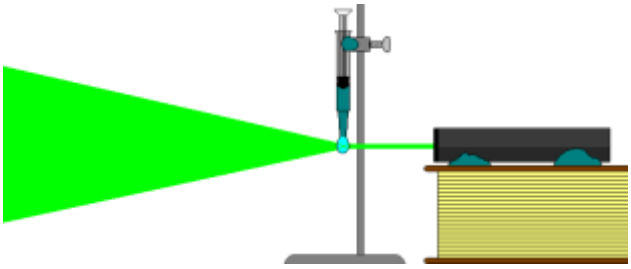
Laser Microscope

Overview: Did you know that you can use a laser to see tiny paramecia in pond water? We're going to build a simple laser microscope that will shine through a single drop of water and project shadows on a wall or ceiling for us to study.



Here's how it works: By shining a laser though a drop of water, we can see the shadows of objects inside the water. It's like playing shadow puppets, only we're using a highly concentrated laser beam instead of a flashlight.

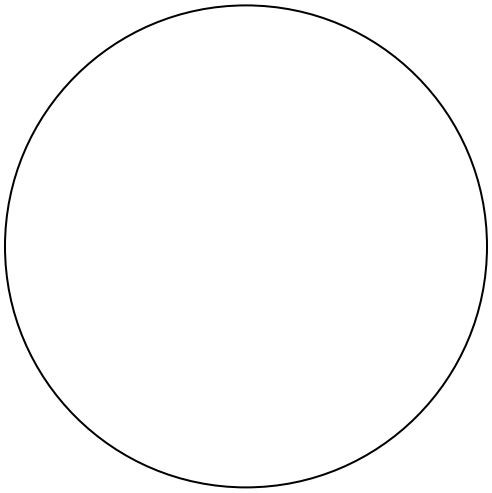
What to Learn: Light travels in straight lines except when the medium it travels through changes.

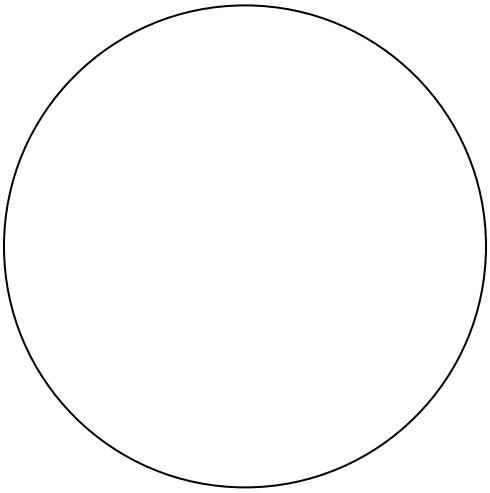
Materials

- red laser
- large paperclip
- rubber band
- stack of books
- white wall
- pond water sample (or make your own from a cup of water with dead grass that's been sitting for a week on the windowsill)
- pliers

Experiment

1. To bend the paperclip, open it up first. Then open one end, bringing that end up. You can make a loop in this end by using the pliers.
2. Attach the clip to the laser using the rubber band, wrapping it around several times.
3. Bend the wire so that when the laser is on, the beam goes through the loop.
4. Dip the loop (NOT the laser!) into the water. It should be small enough to hold a drop of water.
5. Turn down the lights so that you can see the images better.
6. Use a white surface, like a wall or ceiling, to direct your laser onto. Adjust the focus by moving the laser back and forth until you find the spot where things look clearest.
7. Draw what you see from two different water samples in the circles provided. Label each one!





Reading

Here's how it works: By shining a laser though a drop of water, we can see the shadows of objects inside the water. It's like playing shadow puppets, only we're using a highly concentrated laser beam instead of a flashlight.

If you're wondering how a narrow laser beam spreads out to cover a wall, it has to do with the shape of the water droplet. Water has surface tension, which makes the water want to curl into a ball shape. But because water's heavy, the ball stretches a little. This makes the water a tear-drop shape, which makes it act like a convex lens, which magnifies the light and spreads it out.

Exercises

1. Does this work with other clear liquids?

2. What kind of lens occurs if you change the amount of surface tension by using soapy water instead?

3. Does the temperature of the water matter? What about a piece of ice?

4. Does this work with a flashlight instead of a laser?

5. Do lasers hurt your eyes? How?

Answers to Exercises: Laser Microscope

1. Does this work with other clear liquids? (Yes, but each liquid has its own *index of refraction*, which means it will bend more or less than with the water depending on its optical density.)
2. What kind of lens occurs if you change the amount of surface tension by using soapy water instead? (Soapy water kills the surface tension of the water, so you will not be able to use it as a magnifier. The light will pass virtually straight through since there's no curvature of the surface.)
3. Does the temperature of the water matter? What about a piece of ice? (Yes, water is most dense at 4◦C.)
4. Does this work with a flashlight instead of a laser? (No, because the light source is not concentrated enough.)
5. Do lasers hurt your eyes? How? (Magnifying lenses, telescopes, and microscopes use this idea to make objects appear different sizes by bending the light. You'll often see warnings about never pointing telescopes, magnifying lenses, or lasers into eyes. When you concentrate the sun's energy to a single point, the leaf burns. This is exactly what happens at the back of your eye with focused sunlight and laser beams. Never look at intense light with your naked eyes.)